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Project Summary

Evaluation of Containment and Control Options for Methyl Bromide in Commodity Treatment

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Methyl bromide (MeBr) is an ozone-depleting chemical scheduled to be phased out by The Clean Air Act by the year 2001. For agricultural commodity fumigation, there is no ready substitute for MeBr. This study was undertaken to investigate means for MeBr recovery, reuse, and destruction to prevent atmospheric emissions if its limited use were still allowed.

Approximately 4 - 5 million lb/yr (1.8 - 2.3 million kg/yr) of MeBr is used for commodity/agricultural harvest fumigation. Commodity fumigation is carried out extensively at a few locations, mostly major seaports. Fumigation is conducted in chambers built for holding the commodity during fumigation and in temporary enclosure, such as under tarpaulins and in vehicles. The emissions are vented to the atmosphere.

Few control systems exist for MeBr emissions. Likewise, control system research and development has been limited. Vendors have proposed control technologies for MeBr control, recovery, and recycle, but few systems have been built. Conventional vapor control technologies, such as activated carbon adsorption systems, appear to be applicable to MeBr emissions. These systems must also provide for recovery. Control will probably be expensive due to the small volumes of recoverable material and the intermittent nature of fumigation operations.

This Project Summary was developed by EPA's Air and Energy Engineering Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

Methyl bromide (MeBr), with the chemical formula CH_3Br, also called bromomethane, is listed by the 1991 Montreal Protocol as an ozone depleting chemical similar to the other halogenated hydrocarbons such as the chlorofluorocarbons (CFCs). The U.S. Environmental Protection Agency's (EPA's) regulations authorized by the Clean Air Act (CAA) call for a phaseout of MeBr production by the year 2001. This would mean an end to uses of MeBr where the material is emitted to the atmosphere since no future supply of MeBr would be available. In some applications, there is no apparent, ready substitute for MeBr. Therefore, this study was undertaken to investigate possible means for MeBr recovery for reuse and for MeBr destruction to prevent atmospheric emissions if its limited use were still allowed.

MeBr is widely used in U.S. agriculture as a fumigant. A fumigant is a material that can exist as a gas in a concentration lethal to a pest organism. As a gas, it can penetrate the material being fumigated, and then diffuse away after the fumigation ends. MeBr is a very useful general fumigant since it is a permeating gas at ambient temperatures and pressures and since it has a very desirable toxicity to many pest populations.

Table 1 shows that the primary use of MeBr is in soil fumigation, where it is used to kill nematodes and soil insects prior to

Table 1. *Methyl Bromide Use [million lb/yr (million kg/yr)]*

	1991 Use from CPS		1990 Use from NAPIAP	
Total	*47*	*(21)*	*64*	*(29)*
Soil Fumigation	*35*	*(16)*	*47*	*(21)*
Chemical Intermediate	*3.8*	*(1.7)*		
Structural Space Fumigation	*3.8*	*(1.7)*	*4 to 9*	*(1.8 to 4.1)*
Commodity Space Fumigation	*3.8*	*(1.7)*	*5*	*(2.3)*

planting. According to Chemical Products Synopsis (CPS), approximately 75% of the 47 million lb (21 million kg) of MeBr consumed in 1991 in the U.S. was for this application. An additional 8% of MeBr consumption is as a chemical intermediate or as a solvent. The remaining 16% of MeBr consumption is used in space fumigation. Half of that space fumigation is structural fumigation, and half is for commodity fumigation.

The National Agricultural Pesticide Impact Assessment Program (NAPIAP) of the U.S. Department of Agriculture (USDA) has produced use numbers for MeBr that are different from the CPS numbers. However, both sources show that approximately 4 - 5 million lb/yr (1.8 - 2.3 million kg/yr) of MeBr is used for commodity/ agricultural harvest space fumigation.

This study has gathered preliminary data that can be used to determine if some of the essential agricultural commodity fumigation applications of MeBr could be continued by the use of some emission control methods on those commodity fumigation applications.

Conclusions

MeBr Uses and Quantities

Since MeBr uses are relatively restricted, MeBr can be viewed as a specialty fumigant. The consumption of MeBr for space fumigation of commodities represents about 8% of MeBr use. The primary use for MeBr in commodity fumigation is for fruits and nuts. In the treatment of these commodities, there are general commodity containment schemes that are common throughout the industry, although some details may vary with individual installations. The types of configurations for commodity containment are relatively limited.

Fumigation is carried out extensively at a few primary locations, mostly major seaports. Two of the largest ports where MeBr is used are San Diego and Philadelphia. Other major ports include Seattle and Miami, but any port where fruit and nuts are imported is a candidate. Also, fumigation facilities are reported to be present at some airports and military facilities.

Emission Source Characteristics

Emissions sources are characterized in terms of physical configuration and emission stream characteristics.

Physical configurations are divided into two categories: (1) sources with a duct, pipe, or stack outlet, and (2) sources with multiple, irregular outlets. The former occur in chambers specifically built for holding the commodity during fumigation. The latter occur with tarpaulin fumigation or fumigation in vehicles where ordinary leakage or simply an open door is used to vent the MeBr when fumigation is complete.

The emissions arise when air is blown through the commodity to remove the MeBr. Currently the emissions are vented directly to the atmosphere.

Little data are currently available for stream characteristics. Information that is available suggests flow rates in the range of no more than a few thousand to a few tens of thousand of cubic feet per minute air flow with a MeBr content ranging from a few hundred to a few thousand parts per million.

Currently few control systems exist for MeBr emissions. Likewise, research and development related to control system design has been extremely limited.

Various vendors have proposed control technologies for MeBr control, recovery, and recycle. Few systems have been built. Currently, systems are being investigated and the Port of San Diego is installing a MeBr treatment system. Some systems have been installed overseas. Technical details of these systems are not readily available, so that further work would be required to determine how extensively they control emissions and how effective they may be at recovery.

In general, conventional vapor control technologies, such as activated carbon adsorption systems, appear to be applicable to MeBr emissions. However, in the context of minimum or even zero emissions, depending on the regulatory scenario, control systems must also provide for recovery. Conventional approaches using condensation and other methods appear to be applicable here. The fundamental technologies required appear to exist, but the specifics of the application of these technologies to the MeBr control issue require much more investigation and design data acquisition.

Process Economics

Process economics of MeBr control and recovery are not well defined. Scattered data on actual and possible costs of systems were skimpy. Because many components of a control system would appear to rely on existing technologies, costs and the corresponding economics do not appear to be difficult to estimate. Costs can be expected to be comparable to those of other vapor control systems for similar gas stream flow rates.

Preliminary economics of a conceptual design prepared specifically for this report indicate that control will be relatively expensive. The relative expense compared with control systems of similar nature in other applications is based on relatively small volumes of recoverable material that would be handled and the intermittent nature of many of the fumigation operations to which the control system would be applied. At this time, sufficient data are not available for either design or costs to make a definitive statement.

A factor that might considerably influence the economics of MeBr control is the availability of future MeBr supplies. This will be influenced by the regulatory scenario. A total ban, but allowance of the use of existing MeBr inventories with recycle would, in effect, make recycle impractical for technical reasons. Chemical reaction losses would quickly deplete the supply. On the other hand, a selective ban that would allow some manufacture of MeBr to continue might drive up the price, assuming a manufacturer were willing to continue manufacture, because the use volume would be sharply reduced. Unit manufacturing costs would increase sharply.

Current Research and Development Activities

Current research and development activities appear to be underway in several quarters on the very issues discussed in this report. These activities do appear to

be limited at the present time, however. Much of the current work appears to be under the auspices of various vendors of systems and equipment. Some government agencies and industrial groups are showing increasing interest in funding some research. The United Nations Environment Programme (UNEP) has had a leading role in addressing some of these issues.

Information Gaps

In general, information is lacking in two fundamental categories: (1) MeBr emission source characterization and (2) control technology characterization. The fundamental focus needs to shift beyond mere reduction of emissions and toward recovery and recycle. There also needs to be an effort to gather some fundamental performance data related specifically to fundamental stream characteristics. This is especially important because of the reported potential for the accumulation of various commodity chemical components picked up by the MeBr on each cycle of contact with the commodity being fumigated. Detailed economic evaluations based on existing data should be carried out early in order to better direct the research and maximize research efficiency.

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The complete report, entitled "Evaluation of Containment and Control Options for Methyl Bromide in Commodity Treatment," (Order No. PB94-195070; Cost: $27.00, subject to change) will be available only from:
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